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Title: Using sound to ‘see’ through solid objects

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Using sound to 'see' through solid objects

Deep-penetrating capability combined with sharp images makes ACCObeam useful everywhere from oil fields to the health clinic.

By Cristian Pantea

To foil supervillains, Superman relies on his X-ray vision to see through shielded objects to expose dangerous items, such as explosives laced with kryptonite. At Los Alamos National Laboratory, a team of scientists in the Materials Synthesis and Integrated Devices group have invented a technology that works somewhat like Superman's X-ray vision.

Instead of eye beams, this new technology, known as ACCObeam (Acoustic Collimated Beam), uses a new type of sound beam to pierce through physical barriers such as cement, rock and metal and produce high-resolution images of what lies beyond, be it an explosive hidden in a suitcase or an unstable oil well deep in the earth that could fracture and collapse at any given moment.

There are two types of ultrasonic imaging technologies in use today. The first type, known as high-frequency imagers, can create high-resolution images, but they have poor penetration abilities—thick materials such as rock, cement and metals prevent their beams from getting through. The second type, low-frequency imagers, can penetrate thick materials, but their sound beams are so poor they produce hard-to-read images.

Sounding like a ray gun out of science fiction, ACCObeam offers the best of both worlds—it offers the deep penetration capabilities of low-frequency imagers and combines them with the high-resolution capabilities of high-frequency imagers.

ACCObeam operates at relatively low sound frequencies, which means its sound waves can penetrate through two to three meters of rock with relative ease, unlike high-frequency imagers, which penetrate only a few millimeters. ACCObeam's accurately parallel beam ensures that images remain in high resolution, so that personnel reviewing the images have no trouble figuring out just what they're looking at.

To create this innovative sound beam, Los Alamos scientists used a device that converts electricity to sound. The resultant vibrations produce a single narrow sound beam, with the vibrations behaving like concentric ripples on water. It is this specific type of beam that enables deep penetration and produces high-resolution images.

ACCObeam was designed to image wellbores—holes drilled sometimes several miles into the ground to find natural resources, such as oil, gas and water. To reinforce such deep holes, exploration companies typically encase them with materials such as steel and cement. The challenge faced by such exploration is ensuring that such holes maintain their structural integrity, even under extreme heat and pressure. Under such harsh conditions, even a tiny fracture, one

located at the right spot and with the ability to quickly spread out, could cause catastrophic damage by collapsing an entire wellbore.

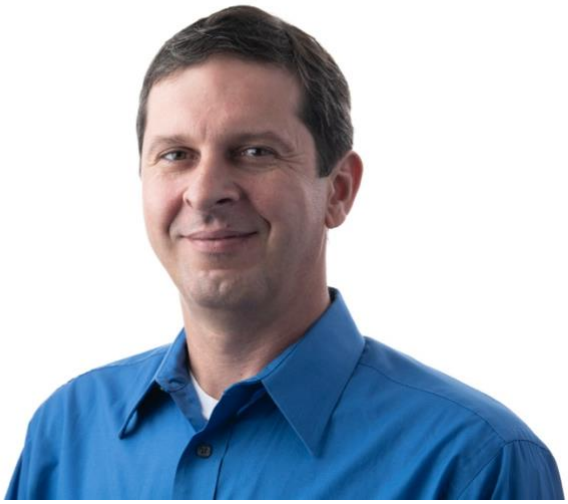
With ACCObeam, it is now possible to inspect any fractures in deep wellbores before they become a problem, enabling companies to prevent disasters and instill public confidence in the underground energy industry. ACCObeam has been described as a game-changing technology when it comes to searching for the natural resources the world has come to rely on.

Los Alamos scientists have found even more applications that can take advantage of ACCObeam's prowess. One future example is in detecting and analyzing explosive threats. One day, ACCObeam could inspect a solid object, such as a suitcase or wall, from a distance through to see if the material inside is an explosive. ACCObeam could become a revolutionary way for emergency responders to safely analyze explosive threats around the world.

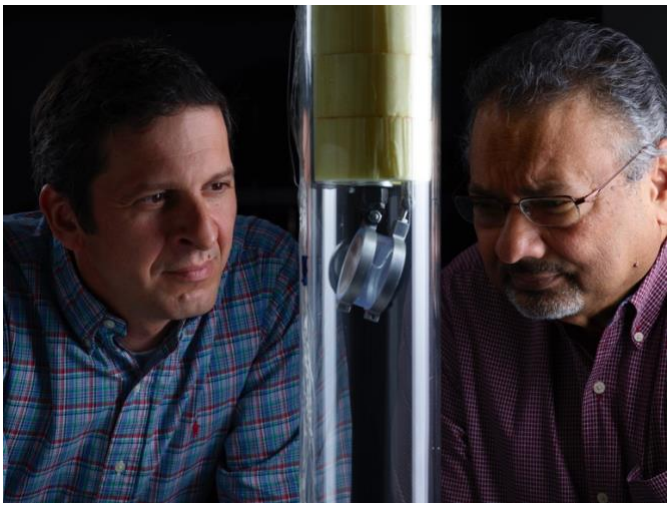
Because ACCObeam's tight beam significantly reduces the chance of interception, it also could be used in long-range communications, imaging, and video transmission beneath the world's deepest oceans.

One possible future application for ACCObeam is in biomedical diagnostics. One day, ACCObeam could be used to remotely charge batteries inside the body and power internal medical devices such as a heart's pacemaker. ACCObeam's combination of deep penetration and high resolution may make it possible one day to better image tumors and various human organs for medical analysis and treatment.

Who needs Superman's X-ray vision, with ACCObeam now at the ready?



Cristian Pantea works as a scientist in Materials Synthesis and Integrated Devices group at Los Alamos National Laboratory.



Cristian Pantea (left) and Dippen Sinha (retired) take a look at their creation, which they call ACCObeam. ACCObeam recently was named a finalist in the R&D 100 competition, the "Oscars of Innovation."